

1 CLAIMS

2 We claim:

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4 1. A method comprising:  
5 initiating a search for images based on at least one query keyword in a  
6 query; and

7 identifying, during the search, first images having associated keywords that  
8 match the query keyword and second images that contain low-level features  
9 similar to those of the first images.

10  
11 2. A method as recited in claim 1, further comprising ranking the first  
12 and second images.

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14 3. A method as recited in claim 1, further comprising presenting the first  
15 and second images.

16  
17 4. A method as recited in claim 1, further comprising:  
18 presenting the first and second images to a user; and  
19 monitoring feedback from the user as to which of the first and second  
20 images are relevant to the query.

21  
22 5. A method as recited in claim 1, further comprising:  
23 presenting the first and second images to a user;  
24 receiving feedback from the user as to whether the first and second images  
25 are relevant to the query; and

1 learning how the first and second images are identified based on the  
2 feedback from the user.

3  
4 6. A method as recited in claim 1, further comprising:  
5 presenting the first and second images to a user;  
6 receiving feedback from the user as to which of the first and second images  
7 are relevant to the query; and  
8 refining the search to identify additional images that contain low-level  
9 features similar to those of the images indicated by the user as being relevant to  
10 the query.

11  
12 7. A method as recited in claim 1, further comprising:  
13 presenting the first and second images to a user;  
14 receiving feedback from the user as to which of the first and second images  
15 are relevant to the query; and  
16 assigning a large weight to an association between the query keyword and  
17 the images deemed relevant by the user.

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19 8. A method as recited in claim 7, further comprising grouping the low-  
20 level features of the images deemed relevant by the user.

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22 9. A method as recited in claim 1, further comprising  
23 presenting the first and second images to a user;  
24 receiving feedback from the user identifying an example image as less  
25 relevant or irrelevant to the query for refinement of the search; and

1 assigning a small weight to an association between the query keyword and  
2 the example image.

3  
4 10. A method as recited in claim 9, further comprising identifying  
5 additional images with low-level features similar to those of the example image.

6  
7 11. A computer readable medium having computer-executable  
8 instructions that, when executed on a processor, perform the method as recited in  
9 claim 1.

10  
11 12. A method comprising:  
12 permitting entry of both keyword-based queries and content-based queries;  
13 finding images using both semantic-based image retrieval and low-level  
14 feature-based image retrieval;  
15 presenting the images to a user so that the user can indicate whether the  
16 images are relevant; and  
17 conducting semantic-based relevance feedback and low-level feature-based  
18 relevance feedback in an integrated fashion.

19  
20 13. A method as recited in claim 12, further comprising ranking the  
21 images.

22  
23 14. A method as recited in claim 12, further comprising using images  
24 indicated as being relevant to find additional images.  
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1 15. A computer readable medium having computer-executable  
2 instructions that, when executed on a processor, perform the method as recited in  
3 claim 12.

4  
5 16. A method comprising:  
6 associating keywords with images to form keyword-image links;  
7 assigning weights to the keyword-image links;  
8 presenting a result set of images obtained from an image retrieval search  
9 based on a query;  
10 receiving feedback from a user as to whether the images in the result set are  
11 relevant to the query; and  
12 modifying the weights according to the user feedback.

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14 17. A method as recited in claim 16, wherein the modifying comprises  
15 increasing the weight of a keyword-image link for images deemed by the user as  
16 more relevant to the query.

17  
18 18. A method as recited in claim 16, wherein the modifying comprises  
19 decreasing the weight of a keyword-image link for images deemed by the user as  
20 less relevant to the query.

21  
22 19. A computer readable medium having computer-executable  
23 instructions that, when executed on a processor, perform the method as recited in  
24 claim 16.  
25

20. A method comprising:

presenting a result set of images that are returned from an image retrieval search of a query having at least one keyword;

monitoring feedback from a user as to whether the images in the result set are relevant to the query;

in an event that the user selects at least one image as being relevant to the query, associating the keyword in the query with the selected image to form a first keyword-image association and assigning a comparatively large weight to the first keyword-image association; and

in an event that the user identifies an example image for refinement of the search, associating the keyword in the query with the example image to form a second keyword-image association and assigning a comparatively small weight to the second keyword-image association.

21. A method as recited in claim 20, further comprising conducting both content-based image retrieval and semantic-based image retrieval.

22. A method as recited in claim 20, further comprising presenting the result set of images in a user interface, the user interface facilitating the user feedback by allowing the user to indicate which images are more relevant and which images are less relevant.

23. A computer readable medium having computer-executable instructions that, when executed on a processor, perform the method as recited in claim 20.

24. A method comprising:  
computing, for each category, a representative feature vectors of a set of existing images within the category;  
determining a set of representative keywords that are associated with the existing images in each category;  
comparing, for each new image, the low-level feature vectors of the new image to the representative feature vectors of the existing images in each category to identify a closest matching category; and  
labeling the new image with the with the set of representative keywords associated with the closest matching category.

25. A method as recited in claim 24, further comprising using use feedback to selectively add and/or remove keywords from the new image.

26. A method as recited in claim 24, further comprising:  
placing the labeled new images into a holding category;  
evaluating the labeled new images in the holding category to determine if any of the keywords associated with the labeled new image match the representative keywords from each category; and  
assigning the labeled new image to the category that best matches the keywords associated with the labeled new image.

1  
2       **27.**     An image retrieval system comprising:  
3       a query handler to handle both keyword-based queries having one or more  
4 search keywords and content-based queries having one or more low-level features  
5 of an image; and

6       a feature and semantic matcher to identify at least one of (1) first images  
7 having keywords that match the search keywords from a keyword-based query,  
8 and (2) second images having low-level features similar to the low-level features  
9 of a content-based query.

10  
11       **28.**     An image retrieval system as recited in claim 27, wherein the feature  
12 and semantic matcher ranks the images.

13  
14       **29.**     An image retrieval system as recited in claim 27, wherein the query  
15 handler comprises a natural language parser.

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17       **30.**     An image retrieval system as recited in claim 27, wherein the query  
18 handler comprises:

19       a parser to parse text-based queries; and

20       a concept hierarchy to define various categories of images.

21  
22       **31.**     An image retrieval system as recited in claim 27, further comprising  
23 a user interface to present the images identified by the feature and semantic  
24 matcher.  
25

1        32. An image retrieval system as recited in claim 27, further  
2 comprising:

3            a user interface to present the images identified by the feature and semantic  
4 matcher to a user, the user interface allowing the user to indicate whether the  
5 images are relevant to the query; and

6            a feedback analyzer to train the image retrieval system based on user  
7 feedback as to relevancy.

8  
9        33. An image retrieval system as recited in claim 27, further  
10 comprising:

11            a user interface to present the images identified by the feature and semantic  
12 matcher to a user, the user interface allowing the user to identify an example  
13 image; and

14            the feature and semantic matcher being configured to identify additional  
15 images that contain low-level features similar to those of the example image.

16  
17        34. An image retrieval system as recited in claim 27, further  
18 comprising:

19            a user interface to present the images identified by the feature and semantic  
20 matcher to a user, the user interface allowing the user to identify which images are  
21 relevant to a particular search query; and

22            a feedback analyzer to assign a large weight to an association between the  
23 search keywords and the images identified as relevant by the user.  
24  
25



1 35. An image retrieval system as recited in claim 34, wherein the  
2 feedback analyzer groups the low-level features of the images identified as  
3 relevant by the user.

4  
5 36. An image retrieval system as recited in claim 27, further  
6 comprising:

7 a user interface to present the images identified by the feature and semantic  
8 matcher to a user, the user interface allowing the user to identify an example  
9 image as being less relevant or irrelevant to the query; and

10 a feedback analyzer to assign a small weight to an association between the  
11 search keywords and the example image.

12  
13 37. An image retrieval system as recited in claim 36, wherein the feature  
14 and semantic matcher identifies additional images with low-level features similar  
15 to those of the example image.

16  
17 38. A database structure stored on one or more computer-readable  
18 media comprising:

19 multiple image files;

20 multiple keywords; and

21 a semantic network to associate the keywords with the image files, the  
22 semantic network defining individual keyword-image links that associate a  
23 particular keyword with a particular image file, each keyword-image link having a  
24 weight indicative of how relevant the particular keyword is to the particular image  
25 file.

1  
2 39. A computer-readable medium having computer-executable  
3 instructions that, when executed, direct a computer to:

4 find images using both semantic-based image retrieval and low-level  
5 feature-based image retrieval;

6 present the images to a user so that the user can indicate whether the images  
7 are relevant; and

8 concurrently conduct semantic-based relevance feedback and low-level  
9 feature-based relevance feedback.  
10

11 40. A program as recited in claim 39, further comprising computer-  
12 executable instructions that, when executed, direct a computer to rank the images.  
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14 41. An information retrieval program, embodied on the computer-  
15 readable medium, comprising the computer-executable instructions of claim 39.  
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B4  
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